

Char·rette

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Noun: charrette

a meeting in which all stakeholders in a project attempt to resolve conflicts and map solutions.

Stakeholder Charrette Recommendations

Site Selection

Jan 27, 2021

In Massachusetts, two networked geothermal (ground source heat pumps) pilots will be installed this year (one in Eversource Gas territory and one in the Merrimack Valley). Networked geothermal is a promising method to provide renewable heating and cooling to buildings in our low-emitting future.

In an effort to support and improve the pilots, HEET is organizing monthly charrettes throughout 2021, where diverse stakeholders share knowledge to identify issues and find solutions.

The first two-hour charrette took place on Jan 21st to develop a list of site selection criteria. Each working group developed criteria for specific viewpoints. This report is a summary of the stakeholders recommendations.

The 70 participants in the charrette included utility executives, regulators, labor representatives, community organizations, advocates, legislators, geothermal designers and installers, and heat pump installers and manufacturers. The charrette working groups produced the following recommendations for site selection for the MA networked geothermal pilots.

HEET deeply thanks all the participants for their work which is shared with gas utilities, state regulators and other stakeholders.

Executive Summary: Stakeholder Recommendations

See Appendix A for the detailed recommendations by the stakeholders.

Site Selection Criteria

Critical

These criteria—marked as “necessary” in Appendix A—surfaced as requirements for the project to proceed. They reflect agreement that an initial installation must involve mixed heating and cooling use, so that the load cancelling and sharing that results will increase system efficiency and reduce size and expense of the needed borehole field. This building mix implies a medium to dense urban area.

Owners, tenants, and building occupants must be willing participants in the demonstration project. They should represent a mix of socioeconomic backgrounds, with a good representation of low-income residents. They are primarily current gas customers, few to none of whom have steam heat in the buildings, since this type of building heat distribution system would need to be replaced, increasing costs for the pilot. Buildings must have adequate electric service.

The gas right-of-way in the street should lend itself to drilling with space for boreholes and no subsurface contamination issues. It should have a good access to bedrock for thermal conductivity. Evaluation of the water for the ground loop to assess quality and thermal conductivity allows for design optimization and ensures the grout is consistent with ground water conditions.

Legislation and regulation governing the pilot includes:

- Wetlands Protection Act
- Chapter 91
- Rivers Protection Act
- Massachusetts Environmental Policy Act
- Designations such as Areas of Critical Environmental Concern
- MassDEP Geothermal Drilling Guidelines
- Municipal grants (i.e. a permit)



Subsurface contamination records may be found in the Boston Water and Sewage Commission online databases.

Recommended

Other points were highly recommended, but not required.

Several considered characteristics of the site itself that could be advantageous:

- A street with leakprone gas pipe could help avoid the cost and disruption of gas pipe replacement (potentially this could be a strong economic benefit)
- A neighborhood with gas constraints could reduce local constraints
- An area with nearby leak-prone pipes could allow the system to “grow” over time into those streets with leakprone pipes
- Selecting an area with a nearby parking lot in case of the need for an expanded borehole array
- Finding a site with bedrock near the surface could shorten drilling time
- Exploring well completion reports at MassDEP over the last sixty years could narrow down potential sites

Recruiting sites

Explaining the benefits of the system (improved indoor air, lower energy bills, air conditioning and improved safety) should help with finding a site.

Potentially the first site should not try to take on every possible challenge. For example, recruiting a single-tenant commercial building, possibly owner-occupied, reduces communication concerns about occupancy interruptions. On the residential side, finding a site with one decision-maker can help smooth the way.

Before the final decision on a site is made, the installer should come to agreement with the building owner on access to mechanical spaces for heat exchangers and service lines. In addition, the installer will need building access for proper commissioning and coordination with HVAC maintenance.

Exploring opportunities to integrate the site with the electric grid or proposing distributed energy resources can make the site islandable and increase learning from this pilot.



Installation

After the site is identified, many groups mentioned a traffic management plan to ease the burden on those traveling through. Another important point was assessing existing infrastructure for energy management opportunities by looking at cooling towers, historical load, generation, storage, and so on.

With drilling, making sure the water (slurry) is managed well is critical, as well as matching the drilling technique to the rock formation. Resources for managing noise and disruption to the site and area can further help avoid disputes. In terms of timing of installation, it is easier to switch out HVAC in the non-winter months to make sure heating is available when needed.

Appendix A

Site Selection

Municipal Criteria

- Dense urban area utilizing a traffic management plan to maximize benefits—**necessary**
- Amenable neighborhoods—**necessary**
- Find a 'typical' architecture to understand if the site could be replicated
 - Triple deckers
 - Lower income
- Quiet side-street neighborhoods
- Zoning: Setbacks with outdoor equipment
- Evaluating the existing heating type system

Opportunities

- Reduce emissions
- Maximizing local jobs by offering job training
- Determine where heat pumps have already been installed?
- Overlap with planned gas pipeline replacement or street paving projects

Concerns

- Understanding landlord-tenant relationship is important
- Avoiding pavement restoration costs by avoiding newly paved streets
- Protect street trees
 - Boreholes and roots
 - Ground temperature
- Constructability - how much will the pilot interfere in people's everyday life
 - Traffic in work area

Site Selection

State Criteria

- Demonstrate feasibility to replicate
 - Maximize benefits
 - Equitable distribution of cost and benefits
 - Setting site based on evaluation priorities
- Laws
 - Wetlands Protection Act—conservation commission
 - Chapter 91—municipal funds for paving
 - Rivers Protection Act—water withdrawal issues?
 - MEPA

- Designations like ACEC (Areas of Critical Environmental Concern)
- Externalities
- Peak electric demand questions/opportunities—**necessary**
 - Site where there is a gas constraint? Avoided costs?
 - Leak prone pipe?
 - Electric grid resiliency?
- Integrate with other grid edge technologies—smart grid technologies—**Necessary**
 - EVs
 - PV
 - Storage

Opportunities

- Emissions reductions
- Ratepayer cost reduction? EE dividends
- Peak shaving
- Enhance applicability of future grid edge technologies

Concerns

- Hazardous waste site
- Challenges to interconnection of future grid edge technologies

Site Selection

Economic Criteria

- Use and choice of contractors
- Inclusive Owner-Tenant Communication—landlord tenant divide, conflict
 - Renter Population (Cambridge is 64%)
- Upgrading to code compliant housing, if not compliant, then it will cost more.
- Ease of electrifying a set of buildings, the easier the better. How much does it cost to retrofit a building?
- Steam system in buildings might be too expensive to retrofit for pilot
- Don't make the first pilot too complicated or expensive.
- Maintenance of system
 - Heat exchangers

Opportunities

- Will it save money
- Scalability - economies of scale over many installations
- Engage different types of consumers

- E.g. non-English speakers
- Location of equipment suppliers
- Possible RE-infrastructure benefit - what else could be improved in the community during construction (e.g. underground microgrid, permeable pedestrian paths, enhance street trees)
- Weatherizing homes
- Real estate value—need to educate brokers, appraisers, and assessors
- Climate resiliency—AC during extreme heat
 - Saving on cooling costs during hot days
- Use pilot as training opportunity
 - Shared learning
 - Future grant opportunities

Concerns

- How much will it cost?
- Real estate value—need to educate brokers, appraisers, and assessors
- Existing contractors might be shut out
- Appliance replacement costs
- Gas system costs moving towards a smaller base of ratepayers
- Rent cost safeguards—avoiding displacement
- Interruption time to get into the pilot
 - In-house work

Site Selection

Residential Participants Criteria

- Mix of socioeconomic backgrounds, but good representation of low-income residents—**necessary**
- Mixed use residential and commercial location—**necessary**
- Site with gas customers (this shouldn't be a opportunity to expand the utility, meaning oil/propane customers)—**necessary**
- Fewer (or no) steam-heat customers
 - Evaluation necessary for non-forced-air systems
 - Where there are groups that can help educate residents
 - Already have a group of willing participants
- Abutting other promising and relevant sites for easy expansion of microgrid, cost avoidance (known gas leaks, residential area slated for pipe replacement)
- Potentially place on Eversource Property that abuts residential area
- Site exposed to the Lawrence gas explosions
- Prioritizing older buildings with low energy efficiency, increase impact. Save more energy. Buildings will be weatherized.

- Single family vs. multi family vs. apartment building
- Buildings in close proximity to each other (surrogate for “close proximity” could be that they are candidates for city sewer as opposed to individual septic)

Notes:

- Promote ways that induction-cooking is better
- Geothermal heat pump uses less energy and costs less than A/C
- Resilience is increased as streets and blocks can support each other
- How much of the heating across the state is steam-boiler driven? When in the pilot will difficulties around steam heat be addressed?
- Are there difficulties with any hydronic system (which is the majority of systems - vast majority of low-income/EJ communities)
- Is a mixed solution possible? E.g. Geothermal + air-source heat pumps
- A backup source can be considered
- We already know the technology works. This pilot is to figure out how it works in the real world.
- Geothermal can be done with multiple systems (“I haven’t met a house that can’t do geothermal in 25 years”)
- If this is for demonstration, in the Boston area take a block (every block has a mix). You’ll get all sorts of challenges.
- Convincing all members of the community is going to be harder than finding a site.
- Demo houses will go a long way. (This is huge).
- Education/marketing is an important challenge

Opportunities

- Lower energy bills (\$20/mo)
- Air-conditioning
- New equipment (fresh start)
- Envelope improvement (energy efficiency)
- Education
- Being on the leading edge
- No explosion or economic hardship
- Can heat domestic hot water
- No risk of monoxide poisoning
- No noise pollution
- Increased resilience
- Controllability of the temperature
- Improve outdoor air quality
- Lower carbon footprint
- Improve indoor air quality
- Get heating and cooling

- Replace aging/old/obsolete heating system (gas or oil furnace, or wood/biomass)
- Learning about non fossil fuel systems of heating and cooling—the existence of these systems may not be known / apparent to people who grew up always heating, cooling, cooking with fossil fuels.
- Eliminate gas in house (may also mean switching to induction cooking)
- Add central AC in home (may not have any AC now)
- Safer heating systems
- Opportunities for integration with distributed renewable energy
- Increase resiliency?

Concerns

- Will it work?
- How much disruption?
- What will it cost?
- Who would service this setup?
- How can I have gas-cooking, grilling, and fireplaces?
- Do I have to have a working relationship with my neighbor?
- Can the grid supply the required amount of electricity?
- What happens to my heat when the electricity goes out?
- What happens to me after the experiment? What will it cost as a regular customer as opposed to a participant in this pilot? (Eversource will switch back for no cost)
- Noise? No.
- How can steam-driven heating systems be replaced?
- Is this not for non forced air systems?
- Duct-work may not be appreciated by some customers
- Gentrification – i.e. will accidentally raise rent prices for people?
- What risks am I taking on, to participate?
- What happens if the pilot doesn't work?
- Upfront capital cost to customers
- Inconvenience caused to residents during installation
- Eventual municipal control? In other words, who reaps the financial benefits of the program in a fair way?
- Customer education (new heating system, new cooking tech (gas vs induction))
- Buildings using combustion for heating will have radiators and/or ducts sized for high temp. So changing system type will require accessing apartments and making adaptations in-unit. This can be disruptive to owners and tenants.
- Do I need deep insulation retrofit / air sealing to make it work? If so, what cost and/or disruption am I facing?
- Where will heat pumps be located? Currently all gas distribution

equipment is underground. Will separate buildings be necessary?

Site Selection

Commercial Participants Criteria

- Mixed energy-use for the pilot (so we can learn the most)—**necessary**
- A commercial district—a strip with one or two stories—not too far from a residential area
- Center of a town for visibility and education
- A balanced system, and then bring in some different systems
- Commercial participants of the pilot project should all be smaller local businesses, ideally those who serve a lower-income neighborhood or group of people
- Mixed use vs. purely commercial district
- Commercial sites that produce and use waste heat
- Sites that can accommodate backup energy systems at pilot stage
- Appropriate diurnal patterns of energy use
- May be easier to recruit a single-tenant commercial building that is owner-occupied (less concerns with interruption of occupied space)
- Identify commercial sites where system doesn't have to be installed in right-of-way in the street (parking lot?)

Notes

- What if a restaurant is a tenant?
- Can one site be in a less dense area? So we can learn how it works in the 'burbs.
- How large can the pilot be? (¼ mile?)
- How much do we want this to be a marketing device?

Opportunities

- Lower energy bills
- Pizza restaurants will like it (?)
- Refrigeration load and heating load can balance each other
- Greening helps with marketing
- Mixed use buildings
- Tenants may be willing to pay more because it's green and as they do for LEED
- Controllability of space temperatures
- Lower maintenance cost

- Night-shift workers can provide variety by helping prove balancing potential
- Lower energy bills
- Some kind of “flagship” commercial operator for PR purposes (university, major hospital, etc)
- Improved outdoor air quality
- PR benefit of participating in a test of clean energy future
- Newer equipment, lower operating and maintenance cost
- System balancing opportunities in mixed use neighbourhoods
- Possibility to add central AC
- Lower carbon footprint
- Is there a good way to link the needs of commercial properties with residential ones? Is this inherent in the physics of a geothermal system, or does it need to be metered, measured, and controlled ?
- Adding to John B's point... old parking lots may be good opportunities for installing geothermal field BEFORE spending money on solar PV canopies.
- Learning about nonfossil fuel systems of heating and cooling. The existence of these systems may not be known or apparent to people who grew up always heating, cooling, and cooking with fossil fuels.
- Free-up footprint space that be converted into rental income value (turn boiler room into rentable storage locker or rentable parking space), could increase their willingness to participate

Concerns

- Will it work
- What can replace the gas?
- How reliable will this be?
- What is the disruption to the business? (tenant's issue)
- Billing and metering
- What costs will I incur after the pilot?
- Owner has to agree, but they don't pay utility bills
- Accidental Gentrification
- How will this affect the maintenance budget?
- How will this affect depreciation of current equipment?
- Compatibility with specific commercial operations (restaurants that do grilling, kilns, certain small industry)
- Insufficient heating and/or cooling based on commercial building type (at pilot stage)
- Construction may disrupt operations or tenants
- Bandwidth of organization to manage project
- Organizational issues re: owner/tenant, who pays, who benefits, etc.
- Commercial may need very short payback periods for investment. Institutions may be willing to accept longer payback periods, could affect their willingness to participate depending on costs to retrofit their building

and resultant payback analysis

Site Selection

Low Income Participants Criteria

- Already have a group of willing participants—**necessary**
- Where there are groups that can help educate residents
- Public housing
- Communities that have experienced negative impact (explosion /asthma)
- Proposed low income housing development
- Single family vs. multi family vs. large apartment building
- Owner occupied vs. rental. Rental will be harder potentially.
- Public housing?
- Triage out high emitting pre-existing heating source (as in, replace oil or wood and biomass if possible)
- Partner with public housing authorities for cost-sharing
- Aligning GeoMicroDistrict installation with asset (gas and steam) retirement—when an aging steam system or gas boiler needs to be replaced anyway. Win-win.
- High population density to increase health benefits from improved air quality, or an area with high childhood asthma or some other vulnerable population, etc

Notes

- Existing system will be kept in place; ideally available as a backup
- Government owned projects?
- Get communities to put in applications will help them bring up the issues and perhaps the solutions (!!) - make it a lottery/contest
- Who is responsible for resolving code violations?

Opportunities

- Lower energy bills (\$5/mo)
- CDC/neighborhood associations may be willing to interface with community members
- More comfortable and healthier buildings
- Affordable housing NPOs might be good opportunities
- Micro-units
- Social justice (low income communities can benefit; electricity rates can be

reviewed and reduced)

- Greenovate program
- Municipalities looking for more green solutions
- Communities that are already doing green projects
- Improve outdoor and indoor air quality
- Increased reliability of heating and cooling, not dependent on a landlord / maintenance department.
- Learning about non fossil fuel systems of heating and cooling. The existence of these systems may not be known or apparent to people who grew up always heating, cooling, and cooking with fossil fuels.
- If housing is owned by a housing authority, may make it easier to deal with single owner
- Lower noise pollution
- Promoting equitable clean energy transition
- Scale / ease of reach given large residential developments (housing authorities, community development corps., etc.)
- Better comfort within home - less maintenance

Concerns

- Will it work? What if it doesn't?
- What will it cost after the pilot?
- Will the gas line be removed? Is it reversible and how?
- What is the maintenance cost?
- Is there enough room in the street for boreholes and gas?
- Having gas in place during the boring can be concerning
- Do I need to buy new pots and pans?
- Gentrification - rents go up?
- Building have any code violations? Can they participate?
- Low income couldn't participate in contest since they aren't owners
- Language barriers might be a problem.
- If I'm renting, how do I have my needs heard vs my landlord?
- If I own, will this cost me anything?
- Accidental gentrification
- Upfront costs associated with necessary energy efficiency/weatherization upgrades
- Skepticism about system working
- Should engage with tenants to make sure there is support all along
- Challenges of procurement for gov't entities running low-income housing

Site Selection

System Design Criteria

- High-rise vs. mid-rise vs. low-rise
 - Segregate three types in terms of performance and results
 - Prioritize medium-to-high density and mixed-use—**necessary**
- Integrate existing assets in buildings to be included (e.g. load, generation, storage, etc.)—**necessary**
- Prioritizing LMI or mixed-income areas and buildings—**necessary**
- Look for heat recovery, simultaneous heating and cooling to minimize impact on loopfield—**necessary**
- Building that have low temperature distribution will simplify the internal upgrades
 - Link up with MassSave
- Look to include buildings with existing cooling towers/dry coolers that could be used to balance the loop.
- Same could be said for buildings with boiler systems to balance on the other end

Opportunities

- Look for load diversity, mixed use
- Prioritize low pressure pipes and areas with planned replacement of pipes (helpful but not critical)
- Distributed pumps may avoid a pump house
- Use assets within included buildings for storage, use, etc.
- Commercial buildings with cooling tower capacity could be used to balance the loop
- Monitoring will help to verify design and allow for adjustments
- Should ideally include residential and commercial hot water to use heat when predominant need is cooling (heat exchange)

Concerns

- Load diversity / mixed use
- Changes in occupancy - impact on energy
 - Business closure
- Most gas lines in MA are medium-density which could prohibit re-use
- Operating hours might change dramatically from design
- Design pumping system to keep energy use down
- Interface building and ground loop to avoid contamination
- Is AHJ amenable to such a project? Will they support it without causing delays?
- Existing building distribution (load side) for heating and cooling
- Cost and comfort issue

Site Selection

System Installation Criteria

- Managing noise and disruption to the site and surrounding area—**necessary**
- Managing drilling equipment on site—traffic control, water and cuttings management—**necessary**
- Mapping existing underground facilities—**necessary**
 - Negative if complicated
 - Positive if other infrastructure improvements can be done at the same time
- Water quality at the location for ground loop—**necessary**
 - Clarify water quality/treatment for the pipes installed
- Proper commissioning—**necessary**
- Need to find some space for boreholes, possibly go with directional drilling to save space—**necessary**
- Time of year for changing over HVAC systems
- Access to mechanical spaces from the common loop
- Existing HVAC maintenance coordination with new systems

Opportunities

- Need for upgrading other underground utilities
- Look for opportunities for horizontal drilling to gain access with less impact

Concerns

- Low temp distribution for heating
- Cost to convert internal systems
- Can you fit drilling equipment
- Navigating / mapping existing underground utilities
- Noise or other disruption
- Time of year to change over heating/cooling
- Accessing mechanical spaces
- Find locations for the boreholes and horizontal piping
- Finding local installation, service and maintenance of outside and inside systems
 - Internal needs Mass Sheet Metal permit
 - IGSHPA accredited installer

Site Selection

Geology and Hydrology Criteria

- Check for subsurface contamination issues on potential sites—Boston Water and Sewer Commission (BWSC) online databases—**necessary**
- Follow MassDEP Geothermal Drilling Guidelines—**necessary**
 - Ensure grout is consistent with ground water conditions
- Typically want a shallow depth-to-bedrock to minimize casing requirements
- Though, some see drilling ease and cost as primary criterion
- Look at existing well completion reports MassDEP dating back to the 1960s
 - Depth to rock
 - Flow rates
- Ability to manage water depending on what the formation gives you and your drilling technique
- Added cost to manage water and cuttings
- Contingencies for undesirable conditions based on initial approach
- Consider the drilling cost based on productivity and water management

Opportunities

- Use water bodies
- Bedrock typically has higher conductivity (esp. with high quartz content)
- Look at existing well completion reports MassDEP dating back to the 1960s
- Utilize heat recovery from sewers. MassDEP is in discussions with City of Boston to pilot this, some companies are looking to try this (temp ~50° F)

Concerns

- Groundwater flow typically too low in NE—any moving water can be additive in part if used optimally
- Ability to manage water depending on the formation and your drilling technique
- Added cost to manage water and cuttings
- Contingencies for undesirable conditions based on initial approach
- Surface water pollution and integration of temperature pollution (i.e. heat is a pollutant)